LUBRIZOL

INTER-OFFICE MEMORANDUM

(1)

To: GWBA

From: LAWM **Date:** [redacted]

Subject: **Level II Support - MoDTC**

Cc: JACK, RVG, EAB, BRD, WBC, WMN, BDD

Gordon,

Attached is the Level II Support for 500 ppm Mo on top of [redacted]. Please forward this data to Steve and Mike at GM.

[redacted] is Lubrizol's general sales [redacted] product. The VM is Lubrizol's standard OCP. The base oils are Group 1 type.

Please note: We ran the IIIE on 250 ppm Mo since at 500 ppm Mo we failed on ORLD twice, 3.09 and 3.39. All formulas were exactly the same except for the level of MoDTC. The MoDTC used was Sakura-Lube.

Lew

LAWM/mjt
Attachment

LEVEL 2 SUPPORT DATA FOR THE ADDITION OF MOLYBDENUM DITHIOCARBAMATE

Formulation	Baseline	Moly @ 500 ppm
Viscosity Grade	5W-30	5W-30
LZ 9800TM	X	X
Base Stocks		
Ashland 100N	88.0	88.0
Ashland 325N	12.0	12.0
Viscosity Modifier		
LZ 7070	8.20	8.20
Pour Point Depressant		
LZ 7749B	0.20	0.20
Dispersant/Inhibitor Package		
TBN	5.50	5.51
%Mo	-	0.044
%Mg	0.023	0.023
%Na	0.024	0.024
%Ca	0.092	0.092
%SA	0.659	0.659
%P	0.092	0.092
%Zn	0.101	0.101
%N	0.064	0.065
%S	0.485	0.460
CRC L-38	Pass	Pass
BWL (40 mg max.)	17.2	15.4
PSV (9.0 min.)	9.80	9.80
Sequence IID	Pass	Pass
AER (8.46 min.)	8.52	8.65
Sequence IIIE	Pass	Pass*
Hours to 375% Vis. Inc. (64 min.)	73.2	73.5
AES (9.16 min.)	9.58	9.56
APV (8.86 min.)	9.03	9.26
RLD (3.46 min.)	5.47	3.53
CLWM (64 um max.)	49	12
CLWA (30 um max.)	12.9	7.0
Oil Related Stuck Rings (none)	None	None
Sequence VE	Pass	Pass
AES (8.96 min.)	9.36	9.29
RCS (6.96 min.)	8.64	9.16
AEV (4.96 min.)	5.86	5.43
APV (6.46 min.)	6.82	7.39
CWM (15 um max.)	0.80	8.5
CWA (5 um max.)	1.03	3.87

* = % molybdenum = ~250 ppm.

LEVEL 2 SUPPORT DATA FOR THE ADDITION OF MOLYBDENUM DITHIOCARBAMATE

Formulation	Baseline	Moly @ 500 ppm	Baseline	Moly @ 500 ppm
Viscosity Grad	5W-30	5W-30	5W-30	5W-30
OS Number	115072	128465	1131-108549	685-40120
Base Stocks				
Ashland 100N	88.0	88.0	90.0	90.0
Ashland 325N	12.0	12.0	10.0	10.0
Viscosity Modifier				
LZ 7070	8.20	8.20	8.10	8.10
Pour Point Depressant				
Viscoplex 1-330	-	-	0.20	0.20
LZ 7749B	0.20	0.20	-	-
Dispersant/Inhibitor Package				
TBN	5.50	5.51	5.12	5.10
%Mo	-	0.044	-	0.046
%Mg	0.023	0.023	0.037	0.037
%Na	0.024	0.024	0.059	0.059
%Ca	0.092	0.092	0.048	0.048
%SA	0.659	0.659	0.688	0.688
%P	0.092	0.092	0.095	0.095
%Zn	0.101	0.101	0.105	0.105
%N	0.064	0.065	0.053	0.053
%S	0.485	0.460	0.485	0.505
CRC L-38	Pass	Pass		
BWL (40 mg max.)	17.2	15.4		
PSV (9.0 min.)	9.80	9.80		
Sequence IID	Pass	Pass		
AER (8.46 min.)	8.52	8.65		
Sequence IIIE	Pass	Pass*		
Hours to 375% Vis. Inc. (64 min.)	73.2	73.5		
AES (9.16 min.)	9.58	9.56		
APV (8.86 min.)	9.03	9.26		
RLD (3.46 min.)	5.47	3.53		
CLWM (64 um max.)	49	12		
CLWA (30 um max.)	12.9	7.0		
Oil Related Stuck Rings (none)	None	None		
Sequence VE	Pass	Pass		
AES (8.96 min.)	9.36	9.29		
RCS (6.96 min.)	8.64	9.16		
AEV (4.96 min.)	5.86	5.43		
APV (6.46 min.)	6.82	7.39		
CWM (15 um max.)	0.80	8.5		
CWA (5 um max.)	1.03	3.87		
Sequence VIA	Pass		Fail	Pass
EFEI (1.06 min. for 5W-30)	1.13		0.99	1.33

* = % molybdenum = ~250 ppm.

(2)

WOQ1 THE LUBRIZOL CORPORATION 07/18/03
INQUIRY SCREEN 15:43:54
BLEND REQUEST/MATERIAL DEFINITION

Material Name S010-4514-94-15, OS Number . . OS128465

Enterer . .	RKW	Entry Date	[redacted]	Record Type	S
Requestor. .	MW	Calc Unit. .	W	CM Type . . .	BL
Priority . .	A	Blend Amount	82400 G		
Need By Date		Amt to Stock	33281 G	Picklist Stat	PICK
Project . .	T944514	Market Class	A	Blender	SAAB
Subset	15	QA Approved		Blend Date	[redacted]
CMA#	Y	Maj/Min Mods	00 A	RM-4514940015-A-1	
Invent Date	[redacted]	Inventor . .	MW	Invent Dept	5240 WKF
Perf Grade					
Visgrade . .	5W-30	Visgr Source	SAE		
Waste Track	R NSW	7		Release Flag	N

LZ Product

Press ENTER to Continue
000INFN Display successful
F1: Help F3: Main Menu F4: Previous

P/N RESEARCH TEST RESULT (BOARD) DATE: 07/15/03

PRODUCT: S010-4514-94-15, TEST NO:
AS OF 1/1/2000, USE MCR. ONLY HISTORICAL DATA WILL BE AVAILABLE IN WOBC

(3)

REMARKS:
1. REPLACED DISTRIBUTION DURING BREAK-IN.

CMA NO: RM-4514940015-A-1-VE-1-LZ-247
CHEM MATL NAME: S010-4514-94-15, OS NO: OS128465
TEST NAME: W080.045.07 COMP DATE: [redacted] DESC: SEQ.VE DEVL.
RUN NUMBER: 1 LOCATION: WICKLIFFE
VALIDITY: VALID QUALIFIED: QUALIFIED

ID NUMBER: 247-5-41 FUEL BATCH: 43
TEST HOUR: 288.0 ENGINE NO: 81-94-
PASS/FAIL: PASS

SLUDGE DEPOSITS	RATING	ADJUSTED RESULT	VARNISH DEPOSITS	RATING	ADJUSTED RESULT
ROCKER ARM COVER	9.16	9.16	PISTON SKIRTS	7.39	7.39

ENTER - NEXT PAGE, P/-1 - PREVIOUS PAGE, CLEAR - EXIT TRANSACTION

OQ5 THE LUBRIZOL CORPORATION 07/18/03
INQUIRY SCREEN 15:42:38
FORMULA AT ACTUAL STATE

Material Name S010-4514-94-15, OS Number OS128465
Calc Unit . . W CM Type BL

Ingredient		Pct/PPM	Use	Pct W	Pct V	OS#
265-X6052,P	BASE STOCKS	88.0000	B	71.1920	72.0649	OS75287Y
265-X6047,H		12.0000	B	9.7080	9.6219	OS75863K
S762-4513-94-134,S		8.2000	O	8.2000	8.2866	OS115849L
S762-4850-94-718,B		0.2000	O	0.2000	0.1922	OS118095C
S010-4514-94-14,-	CONC	10.7000	O	10.7000	9.8344	

Press ENTER to continue
WOQ5MSGIN Actual information displayed successfully.
F1: Help F3: Main Menu F4: Previous

(5)

WOQ6 THE LUBRIZOL CORPORATION 07/18/03
INQUIRY SCREEN 15:41:55
THEORETICAL ANALYSIS

Material Name 265-X6052,P OS Number OS75287Y
Waste Tracking Number R NSW 7
Ela Name . . . 265-X6052

%Oil	100.0000	%Ca		%S	.2000	%Mo	
Sp.Gr	.8644	%Mn		%N	.0020	%Pb	
TBN		%Co		%B		%K	
TAN		%Mg		%Cu		%Na	
%SA		%Ba		%Cl		%Sr	
%Zn		%P		%Li		%Si	

Title Title Name . . 265-X6052
*(MT)VALVOLINE/ASHLAND CATLETTSBURG 100N HT *USE DIL OIL

Press ENTER to continue
000INFN Display successful
F1: Help - F3: Main Menu F4: Previous

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WOQ6 THE LUBRIZOL CORPORATION 07/18/03
INQUIRY SCREEN 10:09:46
THEORETICAL ANALYSIS

Material Name 265-X6047,H OS Number OS75863K
Waste Tracking Number R NSW 7
Ela Name . . . 265-X6047

%Oil	100.0000	%Ca		%S	.3900	%Mo	
Sp.Gr	.8820	%Mn		%N	.0040	%Pb	
TBN		%Co		%B		%K	
TAN		%Mg		%Cu		%Na	
%SA		%Ba		%Cl		%Sr	
%Zn		%P		%Li		%Si	

Title Title Name . . 265-X6047,H
VALVOLINE, INC.

Press ENTER to continue
000INFN Display successful
F1: Help F3: Main Menu F4: Previous

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WOQ5 THE LUBRIZOL CORPORATION 07/18/03
INQUIRY SCREEN 15:43:18
FORMULA AT ACTUAL STATE

Material Name S010-4514-94-14,
Calc Unit . . W CM Type CN

Ingredient	Pct/PPM	Use	Pct W	Pct V	OS#
S015-4041-94-17,J	9.5000	O	88.7850	87.8868	OS115020C
S217-8226-95-01,C	1.2000	O	11.2150	12.1132	

Press ENTER to continue
WOQ5MSGIN Actual information displayed successfully.
F1: Help F3: Main Menu F4: Previous

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WOQ3 THE LUBRIZOL CORPORATION 07/18/03
INQUIRY SCREEN 15:44:30
RECEIVE OUTSIDE MATERIAL

Material Name	S217-8226-95-01, ←			OS Number	OS117924
Enterer . . .	KJL	Entry Date . .	[redacted]	Requestor . . .	
Project . . .	T958226	Market Class. .	A	Record Type . .	S
Subset . . .		QA Approved?. .		CM Type	UN
CMA #				Invent Date . .	[redacted]
Receipt Date	[redacted]	Document Type		Document Number	
Receipt Amount	1.000	U/M	G	Inv Amount	1
Supplier . .	TONEN				
Supp Batch Id					
Visgrade . .		Visgr Source		Waste Track R	NSW 7
SpGr	.8800	MSDS Avail ?		Competitive Mat	
Blend Title	MO-DTC SAKURA LUBE #100 ←				

Comment . . . TONEN
LZ Material
Press ENTER to Continue
000INFN Display successful
F1: Help F3: Main Menu F4: Previous

(9)

WOQ6 THE LUBRIZOL CORPORATION 07/18/03
INQUIRY SCREEN 15:44:46
THEORETICAL ANALYSIS

Material Name S217-8226-95-01, OS Number OS117924
Waste Tracking Number R NSW 7
Ela Name . . . S217-8226-95-01

%Oil	80.0000	%Ca		%S	4.1600	%Mo	4.1500
Sp.Gr	.8800	%Mn		%N		%Pb	
TBN	1.7000	%Co		%B		%K	
TAN		%Mg		%Cu		%Na	.0090
%SA	6.2528	%Ba		%Cl		%Sr	
%Zn		%P	.0160	%Li		%Si	

Title Title Name . . S217-8226-95-01,
TONEN

Press ENTER to continue
000INFN Display successful
F1: Help F3: Main Menu F4: Previous

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WOQ5 THE LUBRIZOL CORPORATION 07/18/03
INQUIRY SCREEN 15:45:19
FORMULA AT ACTUAL STATE

Material Name S015-4041-94-17, OS Number OS115020
Calc Unit . . W CM Type CN

Ingredient	Pct/PPM	Use	Pct W	Pct V	OS#
[redacted] -c	4.0300	O	42.4210	44.5216	OS48147K
[redacted]	0.8600	O	9.0526	10.0707	
[redacted]	1.3700	O	14.4211	14.8903	OS28802Y
[redacted] -d	0.9200	O	9.6842	7.7467	
[redacted] - e-1	0.6800	O	7.1579	7.3149	OS128676
[redacted] - e-2	0.3000	O	3.1579	3.1944	OS47056H
[redacted]	0.5100	O	5.3684	4.7312	
[redacted]	0.3800	O	4.0000	3.3994	OS45933AA
[redacted]	0.2000	O	2.1053	1.8676	OS101888A
[redacted]	0.2500	O	2.6316	2.2632	OS84147F
[redacted]	90.0000	T	0.0947	0.1101	

Press ENTER to continue
WOQ5MSGIN Actual information displayed successfully.
F1: Help F3: Main Menu F4: Previous

c [redacted] (11)

Lubrizol Confidential **Intermediate Chemical Information** Last Updated: 23JUL03

Generic Name: Polyolefin amide alkeneamine

MSDS Chemical Name(s): Polyisobutenylsuccinic anhydride, product with polyethyleneamines

Primary End Use(s): DISPERSANT

Secondary End Use(s): VISCOSITY INDEX IMPROVER

LZ Product Numbers: [redacted]

Waste Tracking Number: R-NSW-7

Functional Structures

- SUCCINIMIDE
- SUCCINIMIDE, FROM CHLORINE SUCCAN
- SUCCINIMIDE,CO:N(1/0.83)=(6/5) EG[redacted]

Backbone Structures

- ALIPHATIC
- BRANCHED
- MOLECULAR WT SIDE CHAIN 1601-3000 (PBU)
- MOLECULAR WT SIDE CHAIN NUMBER AVERAGE
- OLEFINIC (DIENE, ALKYNE, ETC)
- POLYMER
- POLYMER, BUTYLENES
- POLYMER, HOMOPOLYMER

Elementals - Theory

%B	0	%CO		%MG		%NA		%SI	
%BA		%CU		%MN		%P		%SR	
%CA		%K		%MO		%PB		%ZN	0
%CL	0.3	%LI		%N	0.9	%S	0		

Other Characteristics - Theory

%Sulfonate		Conv_Sulfonate		%Sulfated Ash	
%Salicylate				ZDP Primary %P	
%Phenate		Conv_Phenate		ZDP Secondary %P	
%Carboxylate		Conv_Carboxylate		ZDP Aromatic %P	
%Thiosulfate		Conv_Thiosulfate			
%Oil	55	Specific Gravity	0.91	TBN	15

d [redacted] (12)

Lubrizol Confidential **Intermediate Chemical Information** Last Updated: 23JUL03

Generic Name: Zinc alkyldithiophosphate

MSDS Chemical Name(s): Zinc O,O-di(1-methylethyl 1,3 dimethylbutyl) dithiophosphate

Primary End Use(s): ANTIOXIDANT, ANTIWEAR AGENT

LZ Product Numbers: [redacted]

Waste Tracking Number: R-CRCD-L

Functional Structures

- CONV = 100-150 / NEUTRALS (EG[redacted])
- DITHIOPHOSPHATE (DTP)
- DITHIOPHOSPHATE, SALT *
- DITHIOPHOSPHATE, SECONDARY
- SALT, ZINC

Backbone Structures

- ALIPHATIC
- BRANCHED
- MOLECULAR WT SIDE CHAIN UNDER 169 (

Elementals - Theory

%B		%CO		%MG		%NA		%SI	
%BA		%CU		%MN		%P	10	%SR	
%CA		%K		%MO		%PB		%ZN	11.05
%CL	0.0001	%LI		%N		%S	21		

Other Characteristics - Theory

%Sulfonate		Conv_Sulfonate		%Sulfated Ash	16.575
%Salicylate				ZDP Primary %P	0
%Phenate		Conv_Phenate		ZDP Secondary %P	10
%Carboxylate		Conv_Carboxylate		ZDP Aromatic %P	0
%Thiosulfate		Conv_Thiosulfate			
%Oil	9	Specific Gravity	1.2	TBN	5

e-1 → [redacted]

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Obsolete Intermediate Chemical Information

Lubrizol Confidential

Last Updated: 23JUL03

Generic Name: Alkaryl amine

MSDS Chemical Name(s): Dinonyldiphenylamine

Primary End Use(s): ANTIOXIDANT

Performance Synonyms: 1050-4367, S348-6531-86-12, A755-630-L-80, PRIOLUBE 3999, 1131-88924, OIU-38

Waste Tracking Number: R-HZL DFLT-R

Functional Structures

- AMINE, AROMATIC
- AMINE, MONO
- AMINE, SECONDARY

Backbone Structures

- AROMATIC
- BRANCHED
- INHIBITOR - AMINE
- MOLECULAR WT OVERALL 282-519 (>C20-C37)
- MOLECULAR WT SIDE CHAIN UNDER 169 (

Elementals - Theory

%B		%CO		%MG		%NA		%SI	
%BA		%CU		%MN		%P		%SR	
%CA		%K		%MO		%PB		%ZN	
%CL	0.015	%LI		%N	3.2	%S			

Other Characteristics - Theory

%Sulfonate		Conv_Sulfonate		%Sulfated Ash	
%Salicylate				ZDP Primary %P	
%Phenate		Conv_Phenate		ZDP Secondary %P	
%Carboxylate		Conv_Carboxylate		ZDP Aromatic %P	
%Thiosulfate		Conv_Thiosulfate			
%Oil	12	Specific Gravity	0.94	TBN	120

e-2 [redacted] (14)

Obsolete Intermediate Chemical Information

Lubrizol Confidential

Last Updated: 23JUL03

Generic Name: Olefin sulfide

MSDS Chemical Name(s): Alkyl(C12-C18) sulfide

Primary End Use(s): ANTIOXIDANT

Secondary End Use(s): ANTIWEAR AGENT

Waste Tracking Number: R-NHW-1

Functional Structures

- SULFIDE, UNKNOWN (EG SULFURIZED OLEFINS)

Backbone Structures

- ALIPHATIC
- BRANCHED
- INHIBITOR - SULFURIZED OLEFIN
- MOLECULAR WT SIDE CHAIN 169-225(C12-C16)

Elementals - Theory

%B		%CO		%MG		%NA		%SI	
%BA		%CU		%MN		%P		%SR	
%CA		%K		%MO		%PB		%ZN	
%CL	0.5	%LI		%N		%S	19		

Other Characteristics - Theory

%Sulfonate		Conv_Sulfonate		%Sulfated Ash	
%Salicylate				ZDP Primary %P	
%Phenate		Conv_Phenate		ZDP Secondary %P	
%Carboxylate		Conv_Carboxylate		ZDP Aromatic %P	
%Thiosulfate		Conv_Thiosulfate			
%Oil	15	Specific Gravity	0.95	TBN	0